DRAFT

COBSCOOK BAY TIDAL POWER

TRANSMISSION STUDY

PRELIMINARY RECONNAISSANCE REPORT

United States Department of Energy
Cobscook Bay Transmission Study - ETLP
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PRELIMINARY RECONNAISSANCE REPORT

INTRODUCTION

BACKGROUND

The New England Division, U.S. Army Corps of Engineers, is engaged in a re-evaluation of the tidal power potential in Cobscook Bay, Maine. The study will address economic feasibility and environmental concerns. It will explore various alternative tidal generation schemes as well as non-tidal alternatives which would provide comparable generation.

In order to fully assess the alternatives, estimate costs, and weigh the environmental impacts associated with such a project, it is necessary to also study the transmission system needed to tie this generation into the utility network of the region. The Corps asked the Department of Energy (DOE) to perform all studies related to transmission. DOE, which would have the responsibility of transmitting and marketing the power should the project be constructed, has agreed to participate, and has established a study team comprised of staff from the Bonneville Power Administration, (BPA) headquartered in Portland, Oregon. DOE's portion of the study is being funded by the Corps of Engineers.

SCOPE OF TRANSMISSION RECONNAISSANCE REPORT

This document is in response to the Corps' request for a "Preliminary Reconnaissance Report" discussing the possible transmission systems needed for the various generation schemes to be considered, and major engineering criteria and environmental concerns associated with these transmission lines. It should be noted that the following discussion is based on the study team's first reaction and general knowledge of the situation, without the benefit of detailed investigations. It is quite likely that additional system alternatives will become apparent as we proceed with the study. And most certainly, environmental concerns which we are now unaware of will surface later, as we begin to determine and evaluate actual transmission line corridors.

GENERATION PLANS

To date, the Corps has indicated the levels of generation to be considered are 40-MW, 62.5-MW, 125-MW, and 250-MW. Additional generation levels may be introduced into the study; however, 250-MW appears to be the maximum potential.

SYSTEM PLANNING

STUDY METHODS

The purpose of the system planning studies is to develop and evaluate various transmission plans for the integration of the Cobscook Bay Tidal Power Project into the New England transmission grid. BPA is responsible for conducting the system planning studies. New England Power Planning (NEPLAN) will provide assistance by performing the necessary computer studies.

It has been assumed that the Cobscook Bay project will be energized in 1995 and dispatched as part of the New England Power Pool (NEPOOL) system.

The development of transmission plans for integrating the tidal power involves an analysis of how the generation will fit into the future New England load and resource patterns, future transmission plans of New England utilities, feasible points of connection, and potential power markets. A power marketing study for the Cobscook Bay project is being conducted by the Southeastern Power Administration (SEPA) of DOE.

A base power flow case for 1995 will be developed by NEPLAN to be used as the base for other computer studies in determining transmission requirements for the project. The maximum generation level of 250-MW will be investigated first since it would have the greatest impact on the New England transmission system. Preliminary indications are that transmission additions would be limited to the area east of Bangor for the integration of the tidal generation.

The 1995 base case will represent a January light load condition (50% of winter peak load). The reason for studying a light load case is that maximum power transfers from northern New England to southern New England occur under this condition. The introduction of Cobscook Bay generation into the Bangor Area would add to the north-south power transfers. Figure 1 shows the existing NEPOOL bulk power transmission system in the northern New England states.

System planning studies will evaluate the alternate transmission plans on the basis of costs, right-of-way requirements, and system performance. A recommended plan of service will be proposed for each of the four generation levels.

LOAD AND RESOURCE PROJECTIONS

The January 1978 NEPOOL Forecast for New England projected an annual growth rate of approximately 4.5% between 1978 and 1987, with a winter peak load of

Northern New England Power Supply System

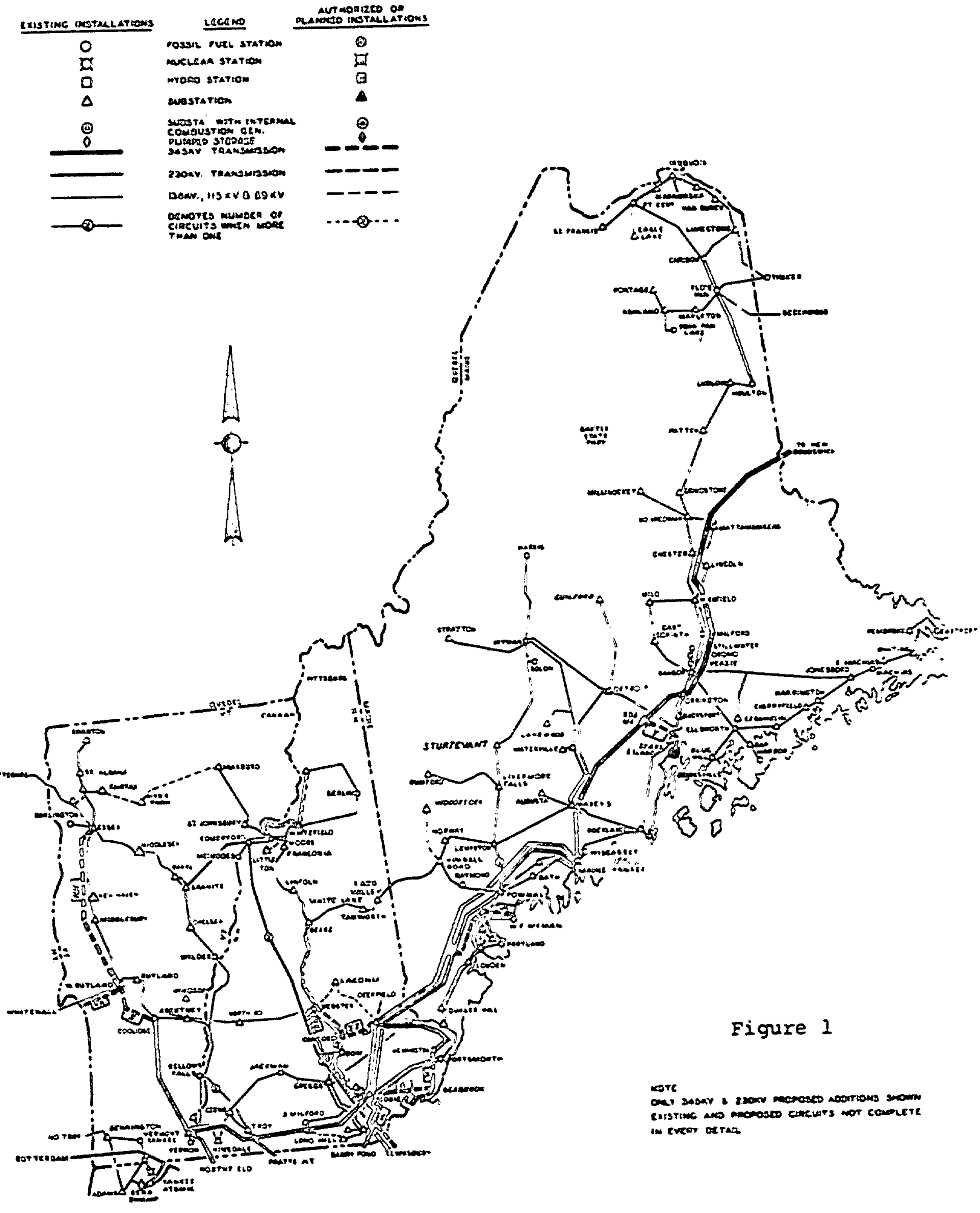


Figure 1

NOTE
ONLY 345KV & 230KV PROPOSED ADDITIONS SHOWN
EXISTING AND PROPOSED CIRCUITS NOT COMPLETE
IN EVERY DETAIL

SCALE-MILES
(APPROX.)

NEW ENGLAND POWER PLANNING

23,440-MW in 1987. If the same rate of growth continues through 1995, the peak load in 1995 would be in order of 33,000-MW - more than double that of the 1978 level of 15,780-MW.

Preliminary 1995 load projections based on information provided by Bangor Hydro and Eastern Maine Electric Cooperative (EMEC) indicate a peak demand of about 110-MW on the Bangor Hydro system east of Bangor, and about 60-MW on the EMEC system.

The NEPOOL long-range generation planning guidelines indicate the following generation mix of future total system capacity:

56 to 62% - Base Load Capacity (all additions to be nuclear)
16 to 20% - Intermediate Cycling Units (fossil-fired)
8 to 11% - Hydroelectric Peaking, Including Pump Storage
9 to 12% - Internal Combustion Peaking

Of the four alternate levels of generation being considered for the Cobscook Bay project, three are single pool schemes and one a double pool scheme. The single pool plants would be operated to produce maximum energy whenever the high tides dictate. The double pool plant could be operated principally for peaking when required and otherwise as a producer of maximum energy. The capacity and estimated annual energy production for each of the alternatives are shown below.

Installed Capacity MW	Estimated Annual Energy KWH
40 (Two Pool)	292,000,000
62.5 (One Pool)	180,000,000
125 (One Pool)	341,000,000
250 (One Pool)	615,000,000

Since the Cobscook Bay tidal power generation patterns can be predicted well in advance, the New England system generation schedules can be designed so that the optimum amount of tidal generation can be absorbed into the system. The ability of the New England system to absorb the tidal power will depend on the must-run level of generation, the time at which the tidal power is available, and the load-following capability cycling thermal plants. The must-run generation includes hydro generation required to maintain minimum river flow or to avoid spilling, minimum oil or coal-fired generation depending on the operating characteristics of the plants, and nuclear generation which for technical or economic reasons is generally not cycled on a daily basis. Hydro pumped storage plants can also be used to absorb the tidal output. Because of the relatively low levels of generation proposed for the Cobscook Bay project (250-MW maximum), it is expected that the New England system can readily accommodate the tidal output.

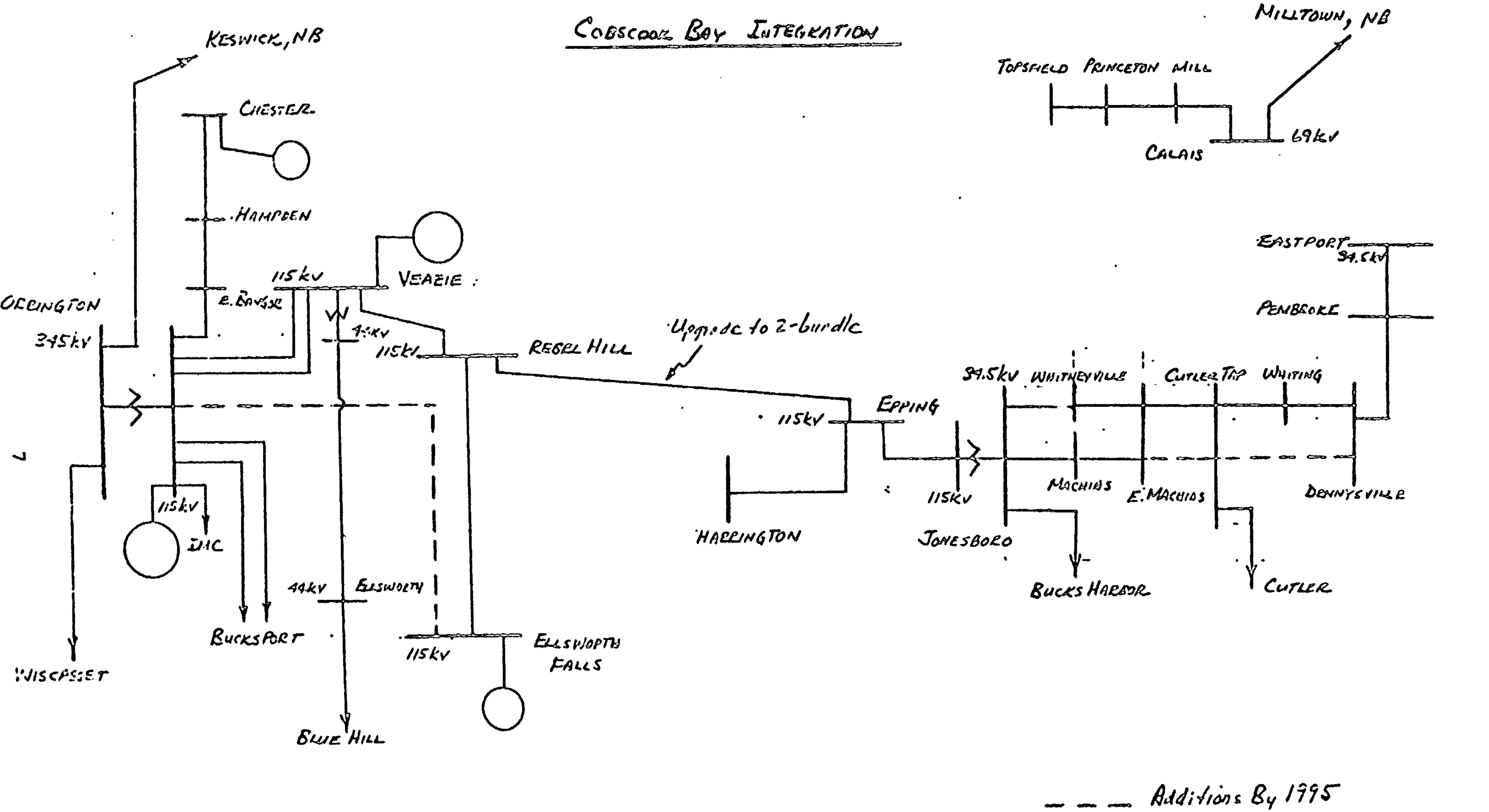
EXISTING TRANSMISSION SYSTEM

The Cobscook Bay project site is located near the town of Eastport, Maine, at the eastern end of the Bangor Hydro transmission system. A 115-kV line extends from the Bangor area to Jonesboro, about 50 miles west of Eastport. Loads between Jonesboro and Eastport are being served at 34.5-kV.

The existing Bangor Hydro system between Bangor and Eastport and proposed additions by 1995 are shown in Figure 2. The 1995 transmission system includes the addition of a single 115-kV line from Orrington to Ellsworth Falls, the bundling of the existing 115-kV line from Rebel Hill to Jonesboro, and the addition of a 34.5-kV line from East to Dennysville.

The Eastern Maine Electric Cooperative (EMEC) system is also close to the Cobscook Bay project site. The major load center is Calais, approximately 30 miles northwest of Eastport. Most of the EMEC load is being served by

COBSCOOK BAY INTEGRATION



BANGOR HYDRO-ELECTRIC SYSTEM TO EASTPORT

FIGURE 2

power purchased from New Brunswick which is transferred over a 69-kV tie between Milltown, New Brunswick, and Calais. It is expected that by 1995, the 69-kV tie with New Brunswick, as well as parts of the EMEC system, will be upgraded to 138-kV. The only connections between Bangor Hydro-Electric and the EMEC systems are at 12.5-kV.

POSSIBLE TRANSMISSION PLANS

Preliminary transmission plans have been developed for integrating the Cobscook Bay project. The transmission plans were based on the consideration of project generation levels, voltages and capacities of existing transmission lines, potential power markets, and probable line terminations. These plans are subject to refinement pending more detailed analyses. Computer studies will be needed to verify the adequacy of these and other plans.

Probable powerhouse locations for the Cobscook Bay project were obtained from previous tidal power studies. For the 40-MW two-pool scheme, the powerhouse is assumed to be located at Leighton Point, on the west side of Cobscook Bay. For the single-pool schemes, the powerhouse is assumed to be located near the Quoddy Indian Village on the east side of the bay. Transmission line routings will be affected by the powerhouse locations.

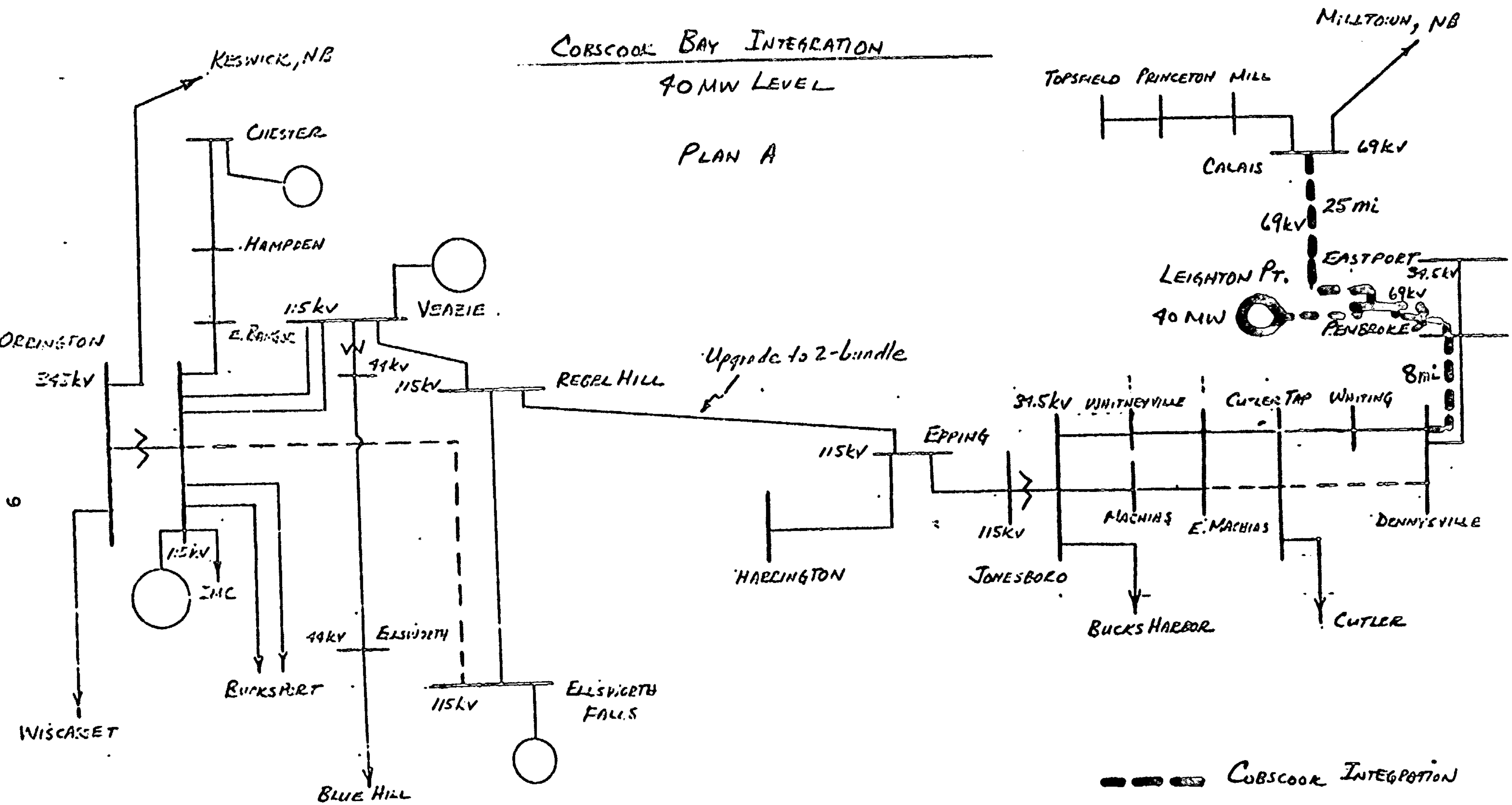
The transmission plans for each of the four generation levels are described below. A 69-kV tie with the EMEC system has been assumed for all of the plans. A portion of the project output can be dedicated to EMEC as part of a power marketing arrangement. Since tidal power was assumed to be non-firm, no transmission was added for reliability with the loss of one circuit.

Plan A - 40-MW Level (Figure 3) - For this level of generation, we have assumed a 69-kV line from a terminal at Leighton Point to Calais. Loads in the Cobscook Bay area can also be served by the project with a connection at Pembroke. Depending on operating conditions, a second 34.5-kV line may also be needed between Pembroke and Dennysville.

CORSCOOK BAY INTEGRATION

40 MW LEVEL

PLAN A



BANGOR HYDRO-ELECTRIC SYSTEM TO EASTPORT

FIGURE 3

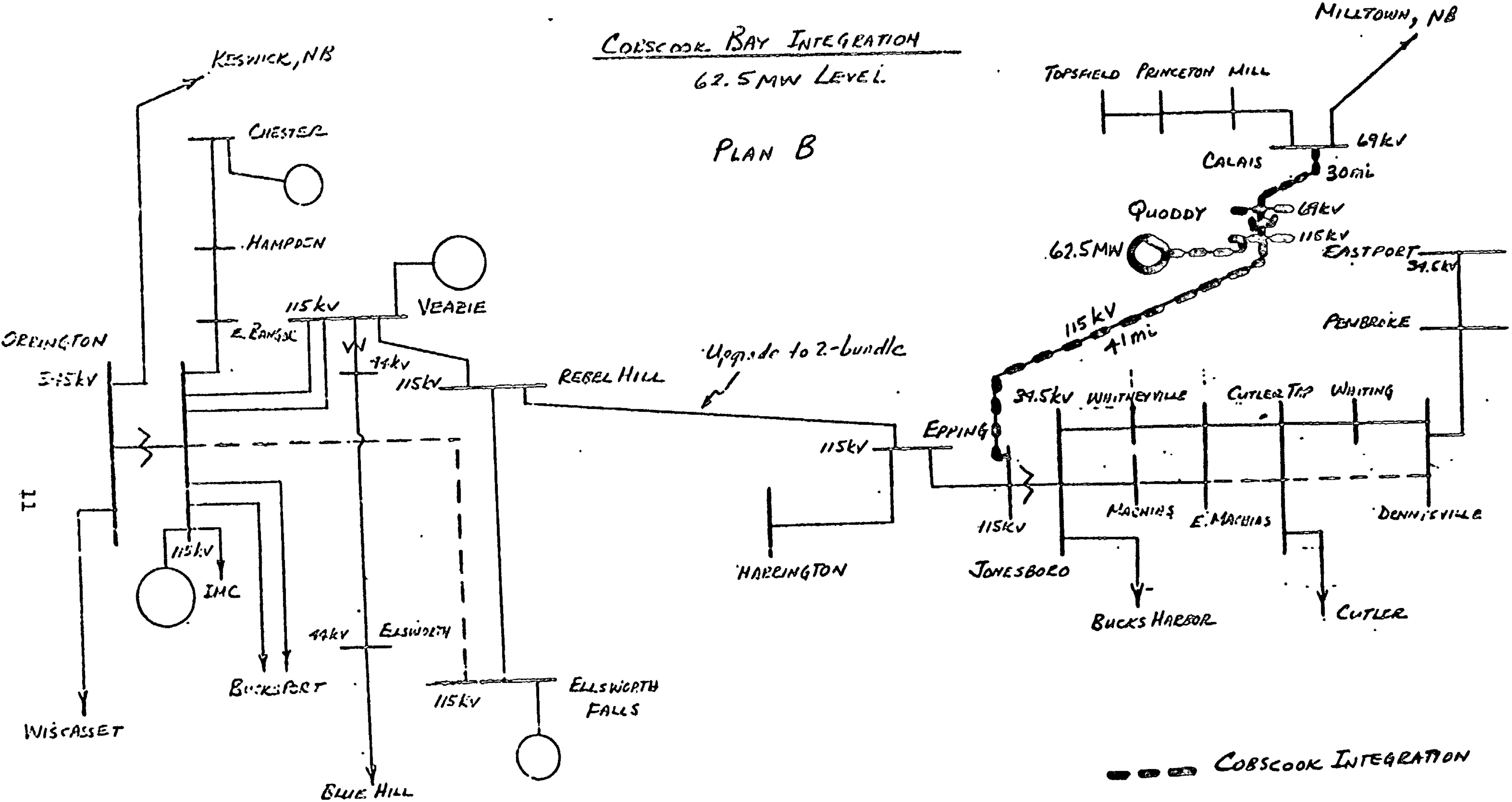
6

Plan B - 62.5-MW Level (Figure 4) - For this level of generation, we have assumed a 69-kV line from the project near Quoddy to Calais, and a 115-kV line from the project to Jonesboro. A transmission plan similar to that proposed for the 40-MW level may be adequate, but it will be marginal under minimum load conditions.

Plan C - 125-MW Level - Two possible transmission plans were considered for this level of generation. Both plans will have a 69-kV line from Quoddy to Calais and a 115-kV line from Quoddy to Epping Substation. In Plan C-1 (Figure 5), the 115-kV line will be continued from Epping to Orrington. More detailed analysis may indicate that the line can be terminated at Rebel Hill. In Plan C-2 (Figure 6), a 115-kV line will be constructed between Epping and Ellsworth Falls.

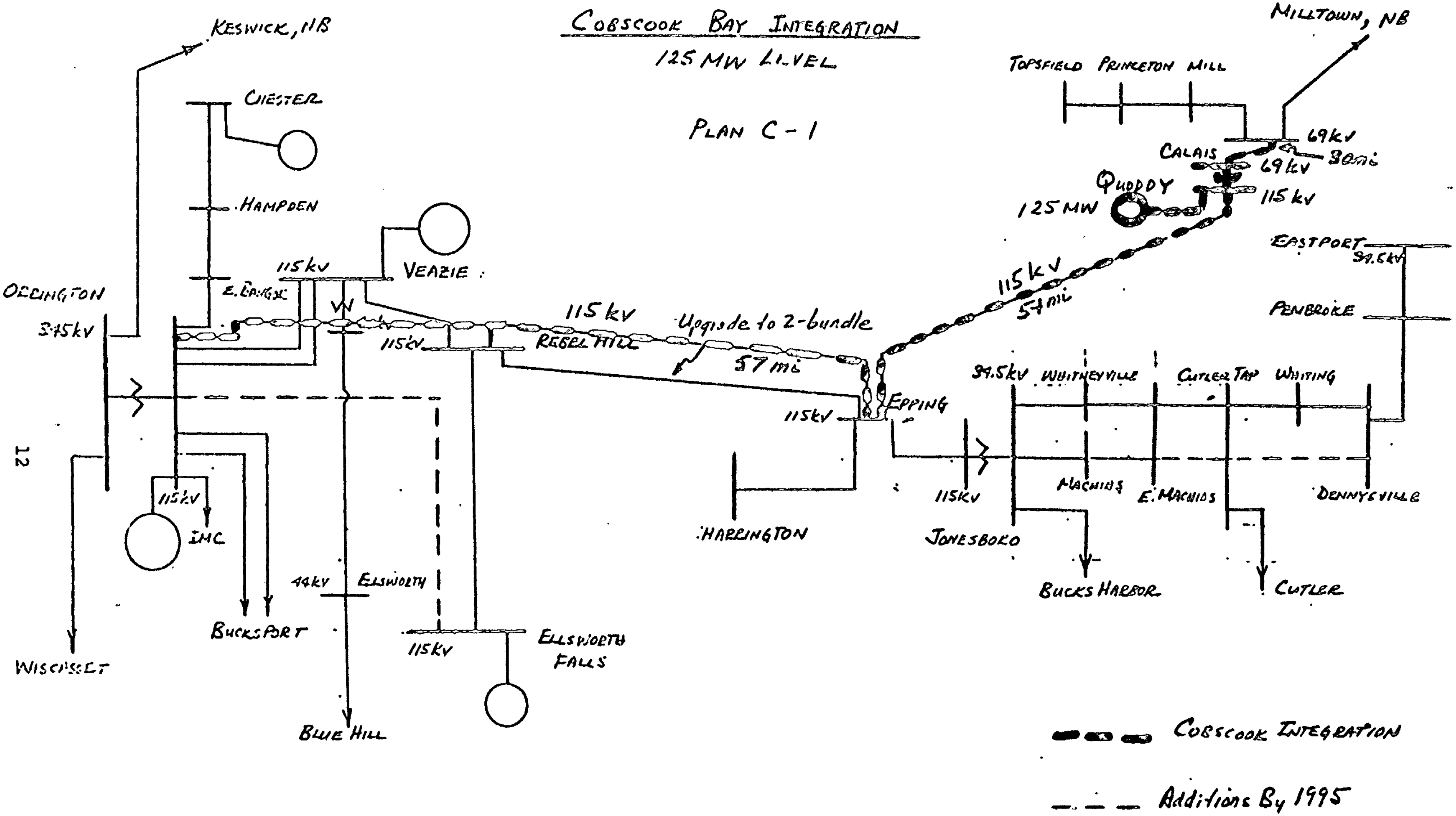
Plan D - 250-MW - Three possible transmission plans were considered for this level of generation. All plans call for a 69-kV line from Quoddy to Calais. In Plan D-1 (Figure 7), we have assumed two 115-kV lines from Quoddy to Epping Substation. One of the lines will continue to Orrington while the other will terminate at Ellsworth Falls. Plan D-2 (Figure 8) will have a 230-kV line from Quoddy to Orrington, with transformation at Orrington and possibly at Epping. The 230-kV line will mean the introduction of a new voltage level into the Bangor Hydro system. Plan D-E (Figure 9) will have a 345 kV line from Quoddy to Orrington with possible transformation at Epping.

The transmission plans described above have not been thoroughly analyzed. Each plan must be evaluated in terms of system performance, cost, and right-of-way requirements with due consideration given to the feasibility of upgrading or replacing existing lines. These plans may be revised and other plans developed as the study progresses.



BANGOR HYDRO-ELECTRIC SYSTEM TO EASTPORT

FIGURE 4



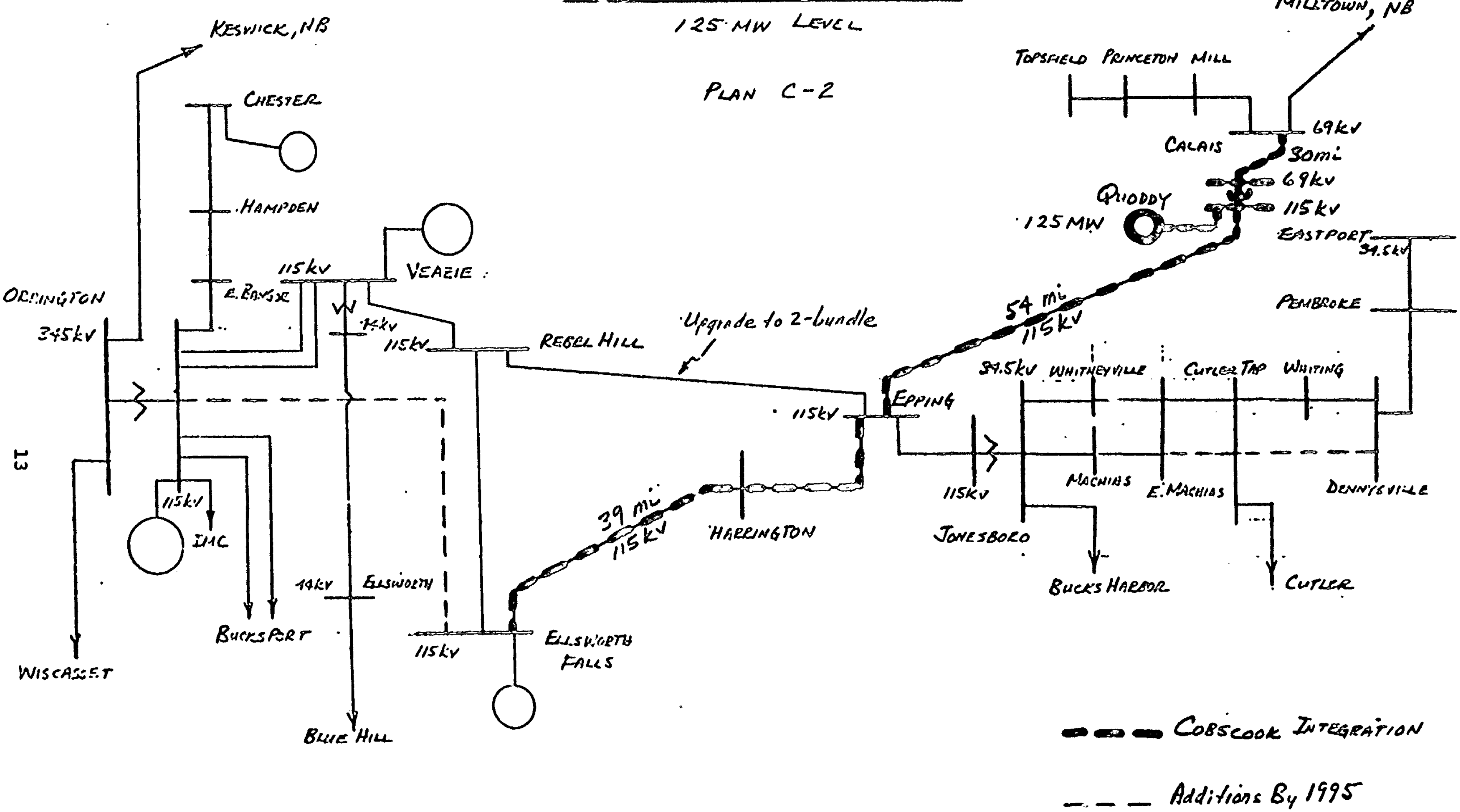
BANGOR HYDRO-ELECTRIC SYSTEM TO EASTPORT

FIGURE 5

COBSCOOK BAY INTEGRATION

125 MW LEVEL

PLAN C-2



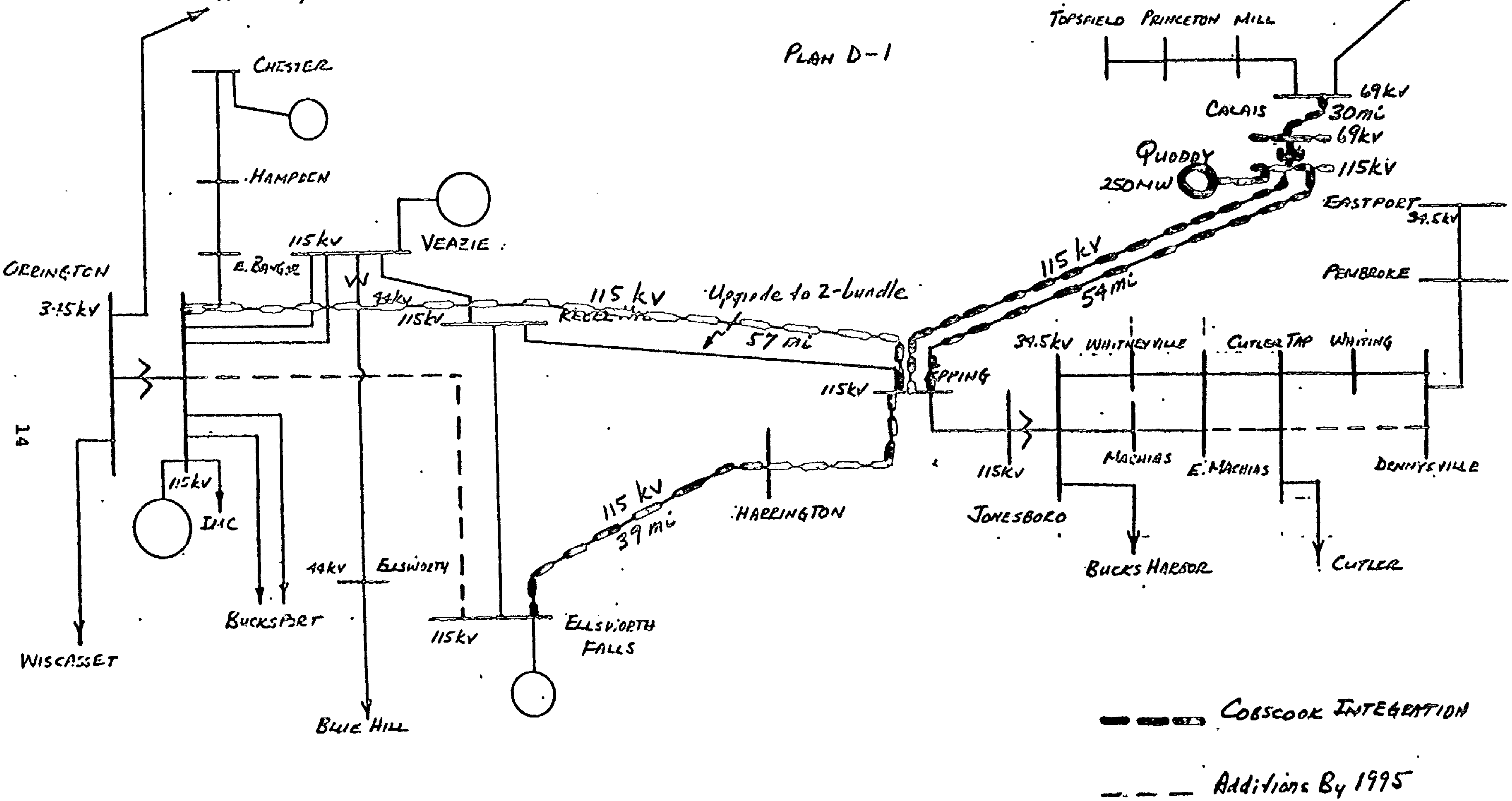
BANGOR HYDRO-ELECTRIC SYSTEM TO EASTPORT

FIGURE 6

Cobscook Bay Integration

250 MW Level

Plan D-1



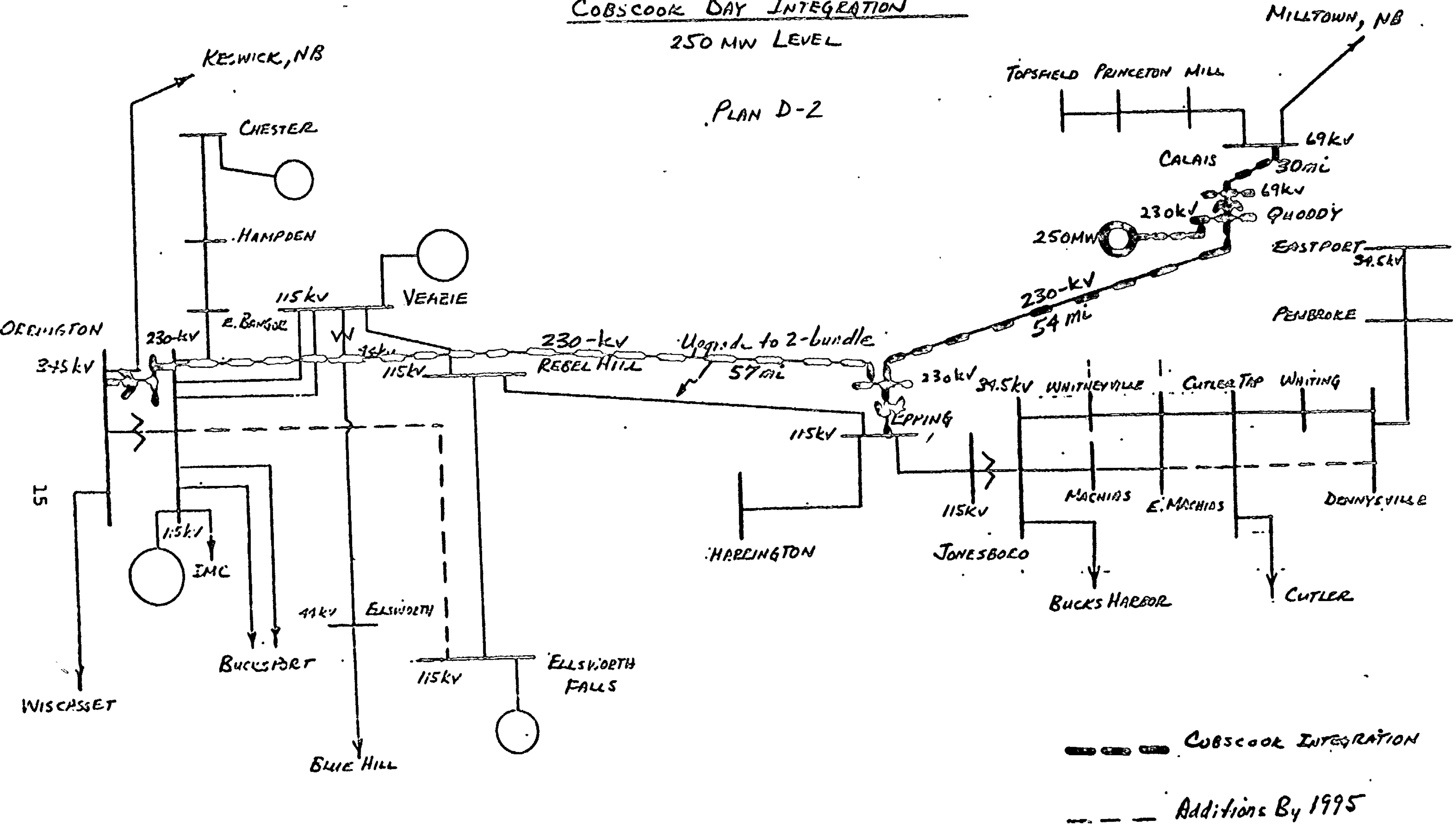
Bangor Hydro-Electric System To Eastport

Figure 7

Cobscook Bay Integration

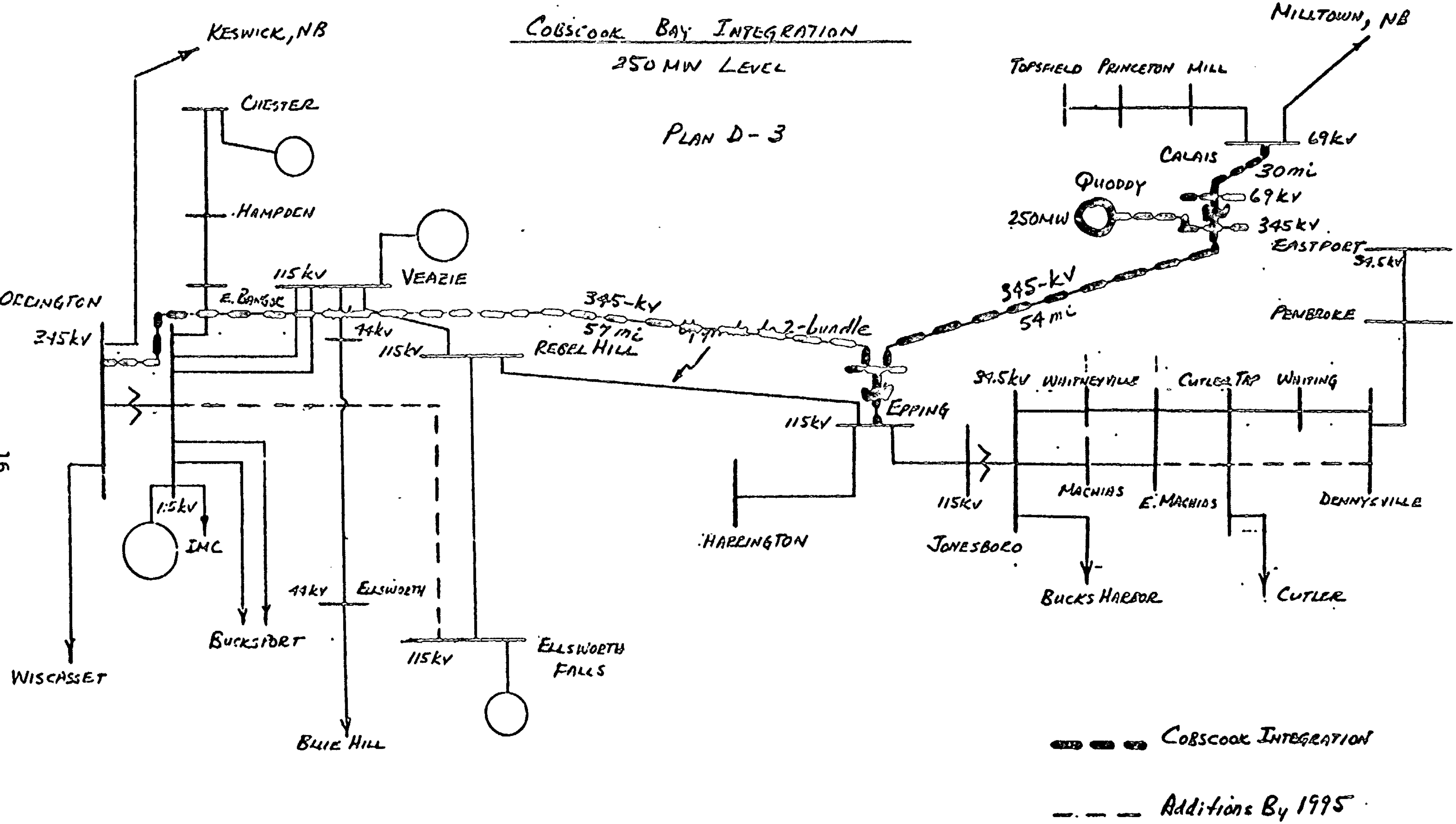
250 MW Level

Plan D-2



Bangor Hydro-Electric System To Eastport

Figure 8



BANGOR HYDRO-ELECTRIC SYSTEM TO EASTPORT

FIGURE 9

Figures 10 through 16 show the above transmission plans in a geographic perspective. The heavy dashed lines indicate the transmission required for each plan. These lines do not represent transmission line routes or corridors which, of course, have not been determined.

COST ESTIMATES

Preliminary cost estimates have been developed for each of the proposed integration plans. These estimates are based on typical costs of transmission and substation facilities and may be revised as the transmission plans become more definite. The investment costs for the various transmission plans are shown in Table 1. These costs do not include interest during construction. Although not included in the cost tabulation, the cost of transmission losses will also be considered in the overall evaluation of the transmission plans.

MAJOR ENGINEERING FACTORS AND ENVIRONMENTAL CONCERNS

STUDY AREA

Geographic Description - The exact boundary of the study area is yet to be determined. However, it is approximated (as shown on Figures 10-16) and contains about 3,000 square miles. The rationale for determining the study area is that it must include all feasible routes for alternative transmission plans for each level of generation. In this case it extends west to Orrington Substation - the probable terminal at the 250-MW level. By the same logic, the area must extend south to include possible routes from Epping to Ellsworth Falls, and far enough north to allow investigation of feasible routes between Eastport and the Calais area. In delineating this approximate study area it was deemed impractical to include the ocean peninsulas, or the areas north of the Grand Lake-Big Lake and or west of the Penobscot River. Large water bodies lying within the study area will show up as absolute constraints during the corridor delineation process, but need not be eliminated at this time.

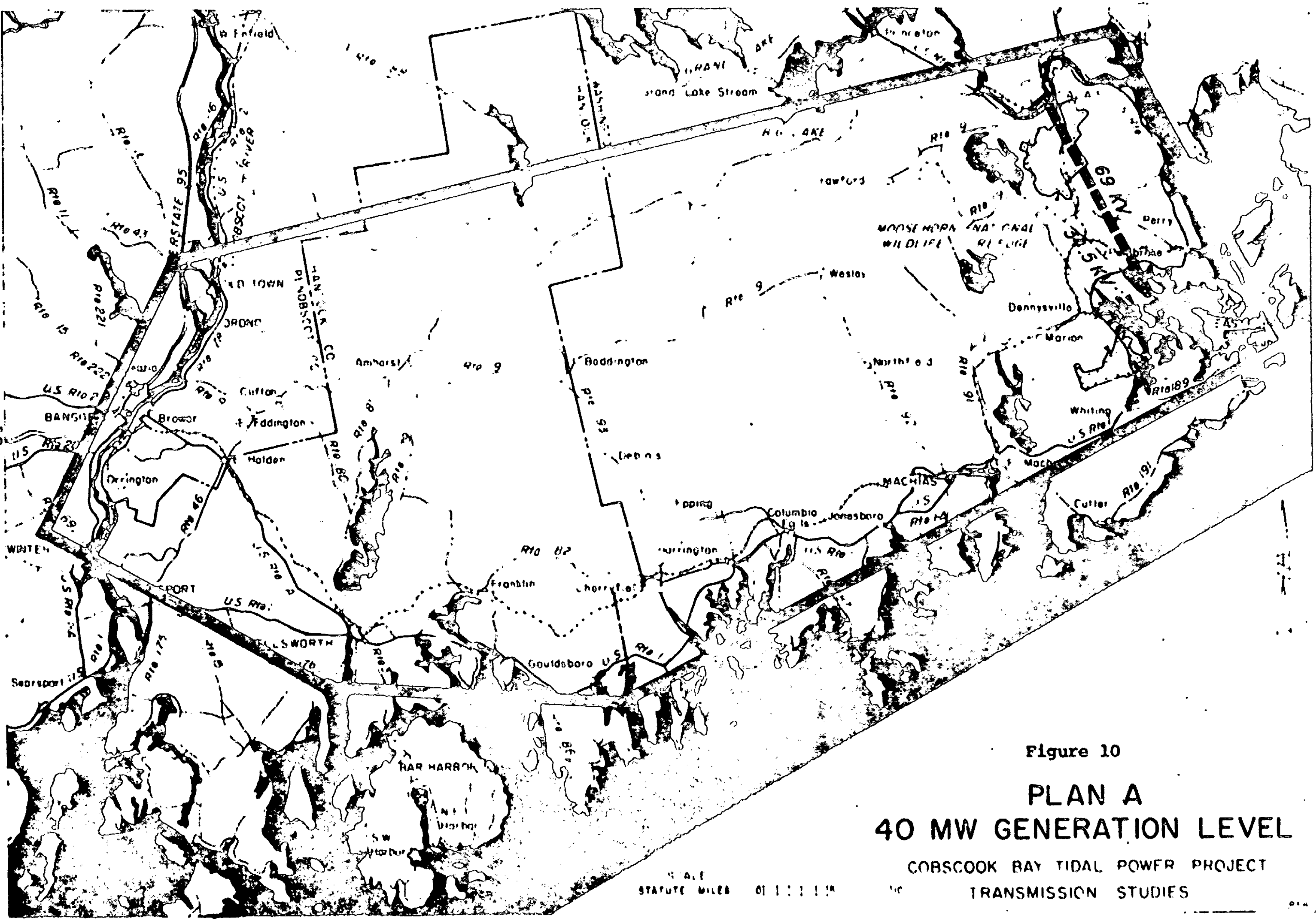


Figure 10

PLAN A
40 MW GENERATION LEVEL

COBSCOOK BAY TIDAL POWER PROJECT
TRANSMISSION STUDIES

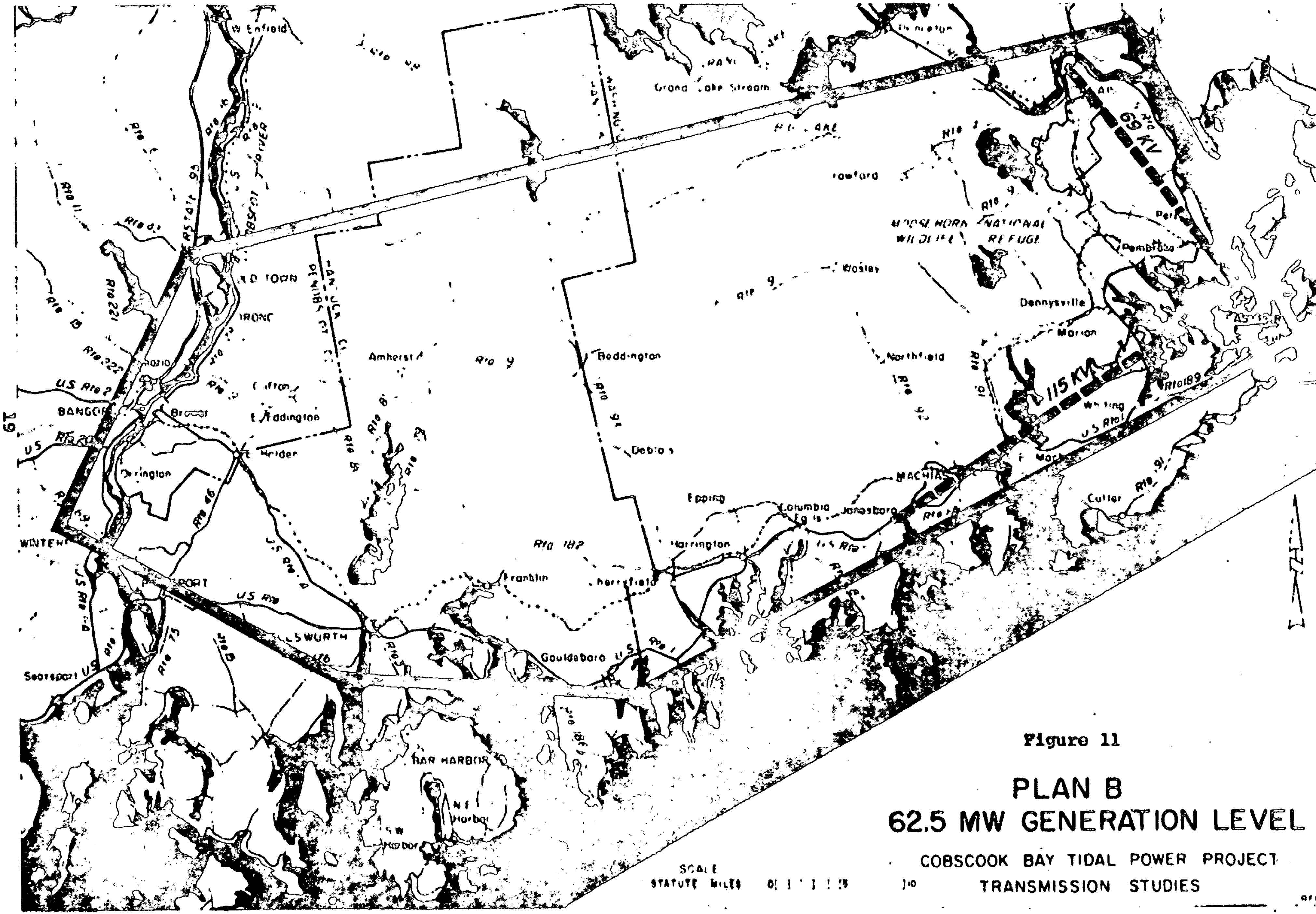


Figure 11

PLAN B
62.5 MW GENERATION LEVEL

COBSCOOK BAY TIDAL POWER PROJECT
TRANSMISSION STUDIES

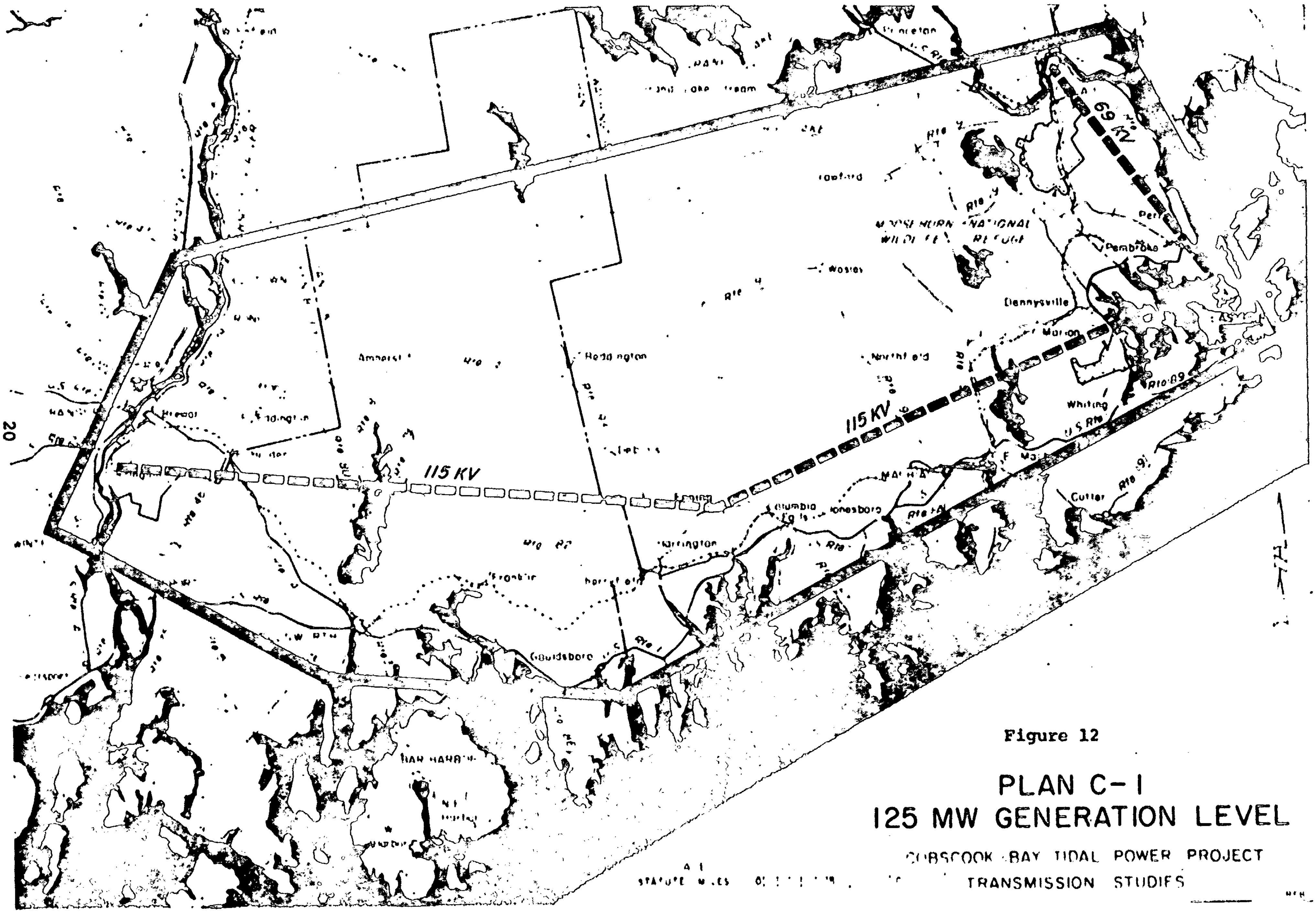


Figure 12

PLAN C-1
125 MW GENERATION LEVEL

COBSCOOK BAY TIDAL POWER PROJECT
TRANSMISSION STUDIES

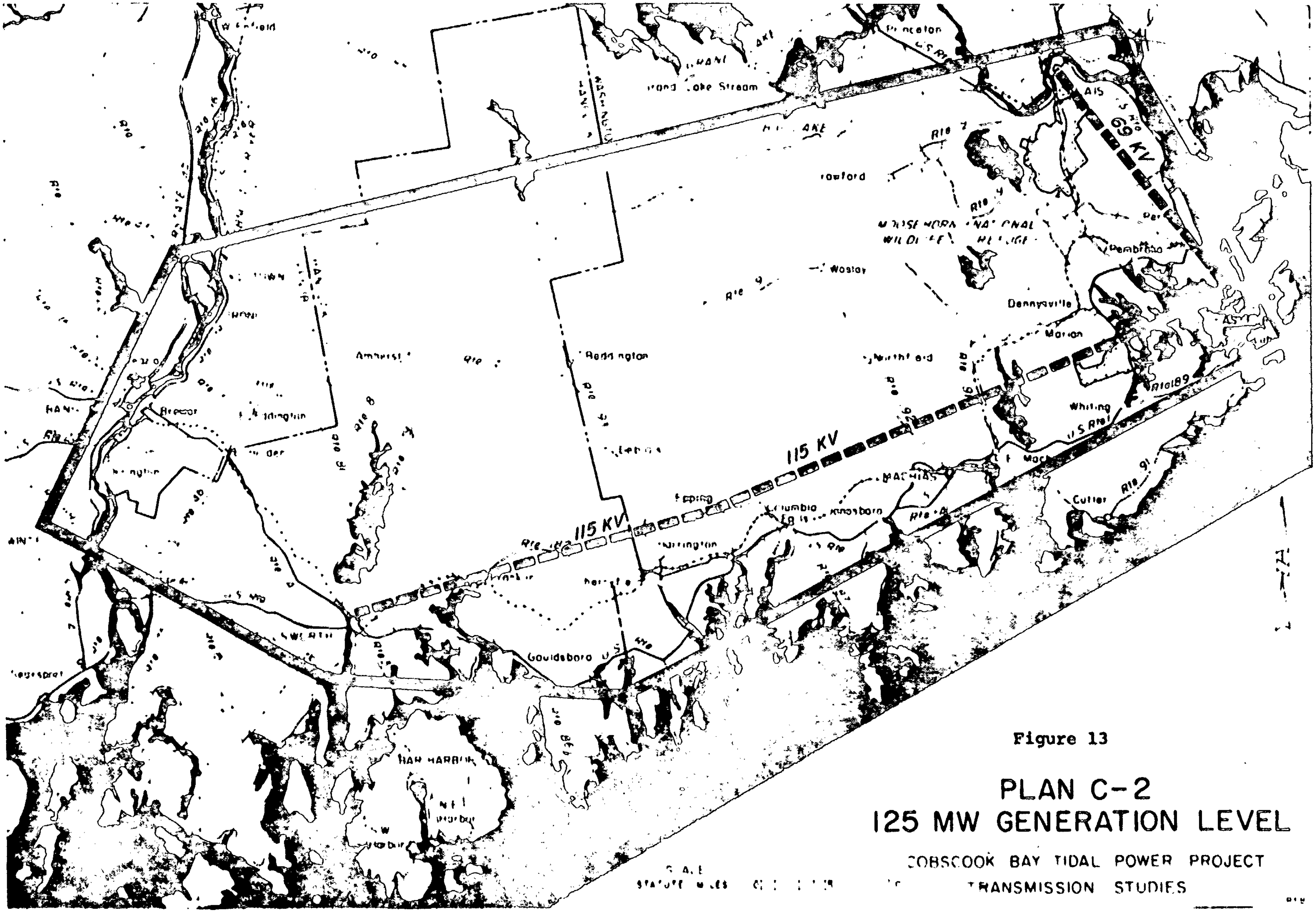


Figure 13

PLAN C-2
125 MW GENERATION LEVEL

COBSCOOK BAY TIDAL POWER PROJECT
TRANSMISSION STUDIES

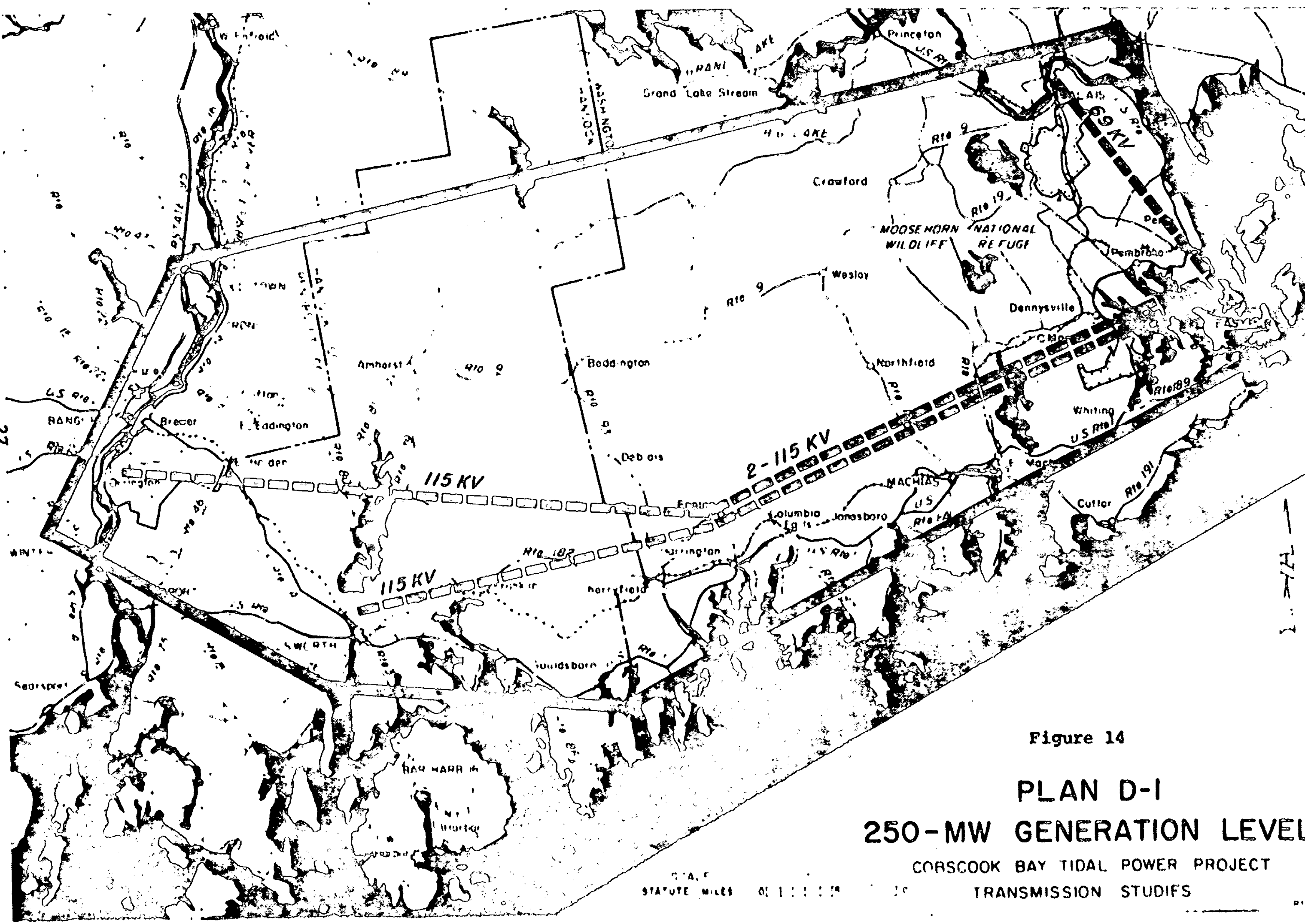


Figure 14

PLAN D-I
250-MW GENERATION LEVEL

CORSCOOK BAY TIDAL POWER PROJECT
TRANSMISSION STUDIES

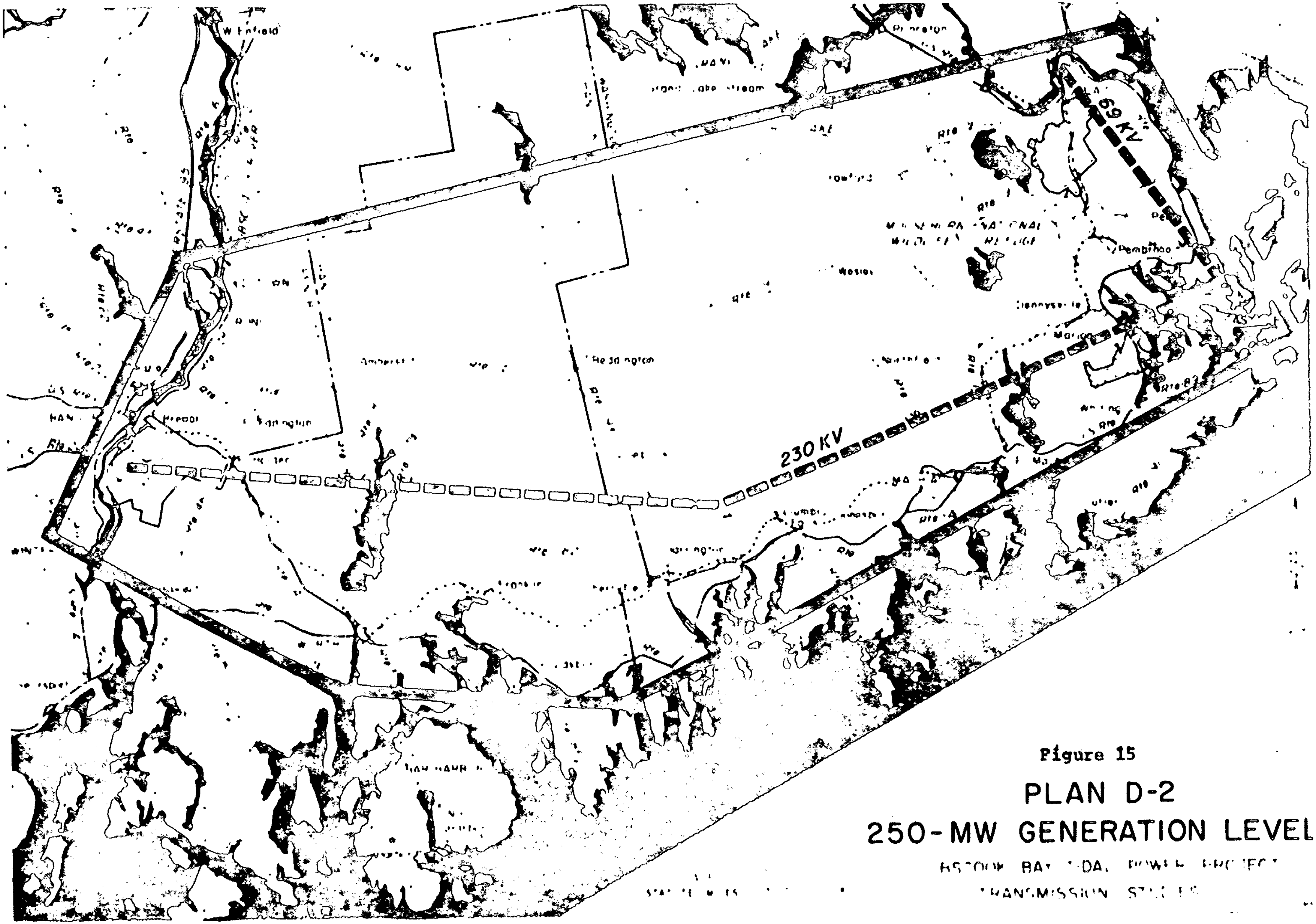


Figure 15

PLAN D-2

250-MW GENERATION LEVEL

COBSCOOK BAY TIDAL POWER PROJECT

TRANSMISSION STUDIES

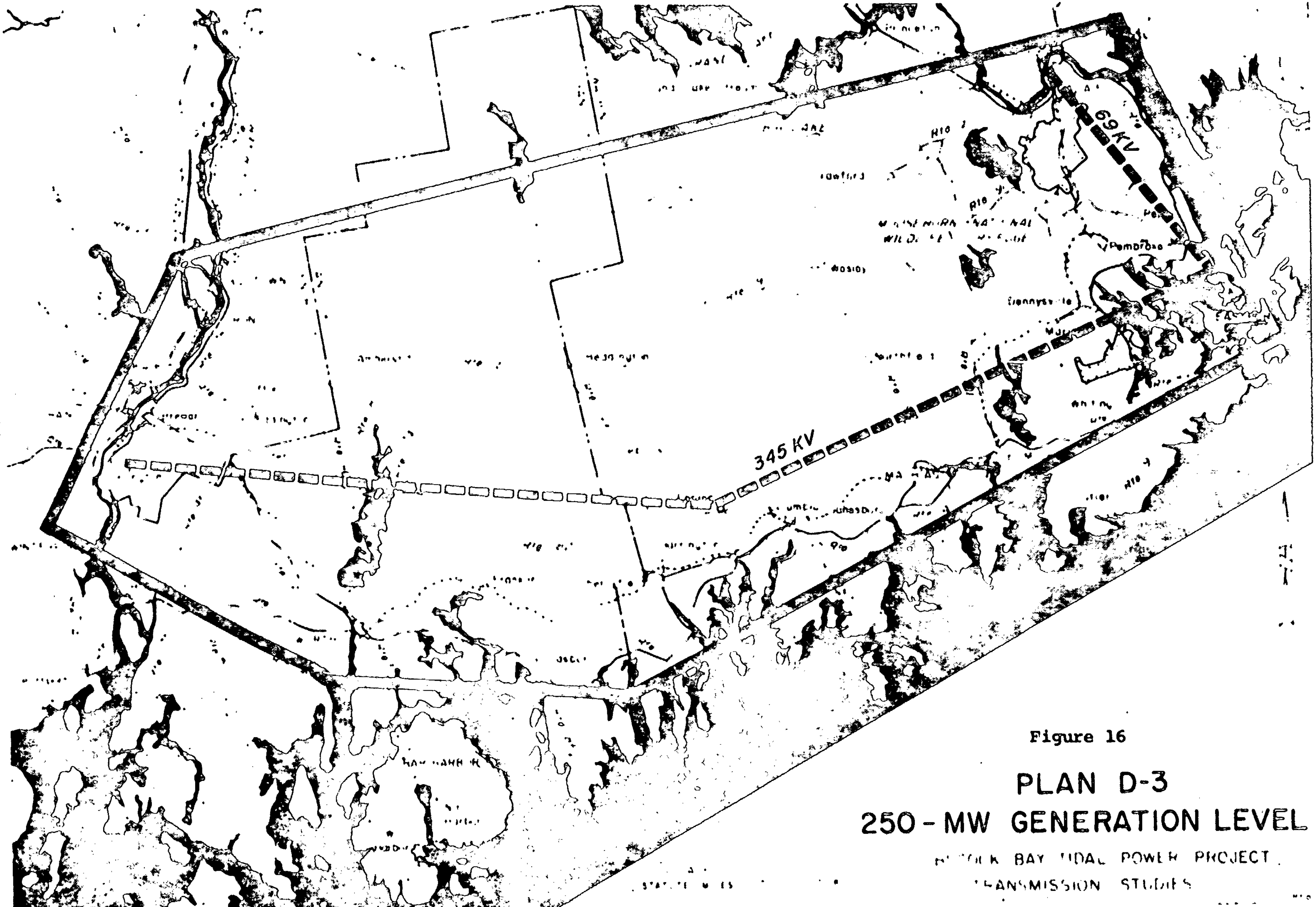


Figure 16

PLAN D-3

250-MW GENERATION LEVEL

BAY TIDAL POWER PROJECT

TRANSMISSION STUDIES

COBSCOOK BAY INTEGRATION

INVESTMENT COST ESTIMATES

	40-MW Level	60-MW Level	125-MW Level		250-MW Level		
	Plan A	Plan B	Plan C-1	Plan C-2	Plan D-1	Plan D-2	Plan D-3
	(000)	(000)	(000)	(000)	(000)	(000)	(000)
Line	3,640	10,570	22,470	19,410	38,280	23,580	25,800
Substation	1,590	2,650	3,380	3,380	4,850	13,800	11,920
Total	5,230	13,220	25,850	22,790	43,130	37,380	37,720

Table 1

Social and Economic Structure - The study area is located in Penobscot, Hancock, and Washington Counties. Population density is greatest in the western portion (Bangor, Brewer, Orrington, etc.) and along U.S. Highway No. 1, close to the coast. The center portion of the study area is sparsely populated (less than 10 persons per square mile). Major population centers are Bangor and Brewer in Penobscot County; Ellsworth in Hancock County; and Machias, Eastport, and in Washington County. Population has shown a gradual decline in past years in the eastern part of the study area, however, recent projections indicate slight future growth. The western portion, with some exceptions, has exhibited population growth. This trend is expected to continue.

Income is derived largely from manufacturing, wholesale and retail trade, and various types of services. Forestry and agriculture are important to the economy, as is tourism, particularly in the southern coastal region. The eastern portion of the study area is somewhat economically depressed. Median income for Washington County is about $2,000 below the state average.

Primary Land Use - Commercial forestry is by far the major land use within the study area.. Among major forest land owners are Georgia-Pacific Corporation, St. Regis Paper Company, and Diamond International Corporation.

Agricultural land use makes up a fairly small percent of the study area but is significant in the western and coastal regions. Also, the Blueberry Barrens, located in the middle of the area is an example of agricultural land use worthy of special mention. Here, thousands of acres of lowbush blueberries are commercially harvested annually - and have been for over 100 years. Although the fruit is wild and native to the area, lowbush blueberry fields are now managed by the use of herbicides, fertilizers, pesticides, honey-bee pollination, and irrigation. Maine is the only state in the United States with a sizeable commercial production of lowbush blueberries.

Most residential land use occurs in communities along U.S. Highways 1 and 1A, on the southern edge of the study area, and along State Route 9 (also referred to as the "Airline Road"), joining Bangor and Calais. These two highways are connected by several north-south state routes, which also exhibit a degree of community development. In addition, some rural residences are scattered throughout the study area.

Recreational land uses are mostly centered around the large number of water bodies in the area. Many lakes and ponds are developed for private summer camps. Public recreational areas include several state campgrounds and parks, and the Moosehorn National Wildlife Refuge in the eastern part of the study area. State Route 182, between Franklin and Cherryfield is a designated scenic highway. Several rivers are used for canoeing and fishing.

Land use planning is carried out by several levels of government. The Maine State Planning Office and other State agencies have planning responsibilities in the area. In fact, the Land Use Regulation Commission (LURC) has direct responsibility for zoning and regulations pertaining to land uses for all unorganized towns. The three regional planning commissions (RPC's) involved in the study area are: Penobscot Valley RPC, Hancock County RPC, and Washington County RPC. Planning is conducted by organized towns at a local level.

ENGINEERING FACTORS

Structure Designs - A variety of structure designs are available for any electrical transmission system. The configuration of structures varies from line to line and generally depends on the amount of power to be transmitted and hence the voltage and ampere rating of the line. The height of structures along a given transmission line also varies depending on many factors such as type of terrain crossed, land use, highway crossings, river crossings, etc. As a general rule, as the voltage of a line increases, the structure size increases and so does the size and/or number of conductors. The width of right-of-way clearing is also a function of the size of the line as shown in Table 2.

An important concept in understanding transmission line design is that structures are designed for each individual line and their size and spacing are influenced by many factors such as topography, wind velocity, icing, footing condition, and land use. Each line is a composition of structures designed to meet safety, reliability, economic, environmental, and compatibility requirements.

Based on a preliminary review of voltage anticipated and existing practices in the study area, the transmission lines associated with this project will be supported by wood pole structures. Three wood pole configurations are shown in Figure 17. These and others will be investigated to optimize a design meeting the finally established criteria.

Under certain conditions, underground transmission will be offered as an alternative to constructing overhead transmission lines. As a general rule, an economic justification cannot be made for underground transmission, as compared to an overhead system. Placing the transmission line underground will be considered where economics can be weighed against environmental or engineering needs, however.

Accessability - Access roads are normally required for construction and maintenance of transmission lines. As a general rule, access is planned to each structure to facilitate movement of equipment and materials during the initial construction phase. With proper planning and location, these roads will then be available for maintaining the facilities throughout their life. In certain areas or under certain conditions, the access roads can have as great or greater impact on the environment as the transmission lines.

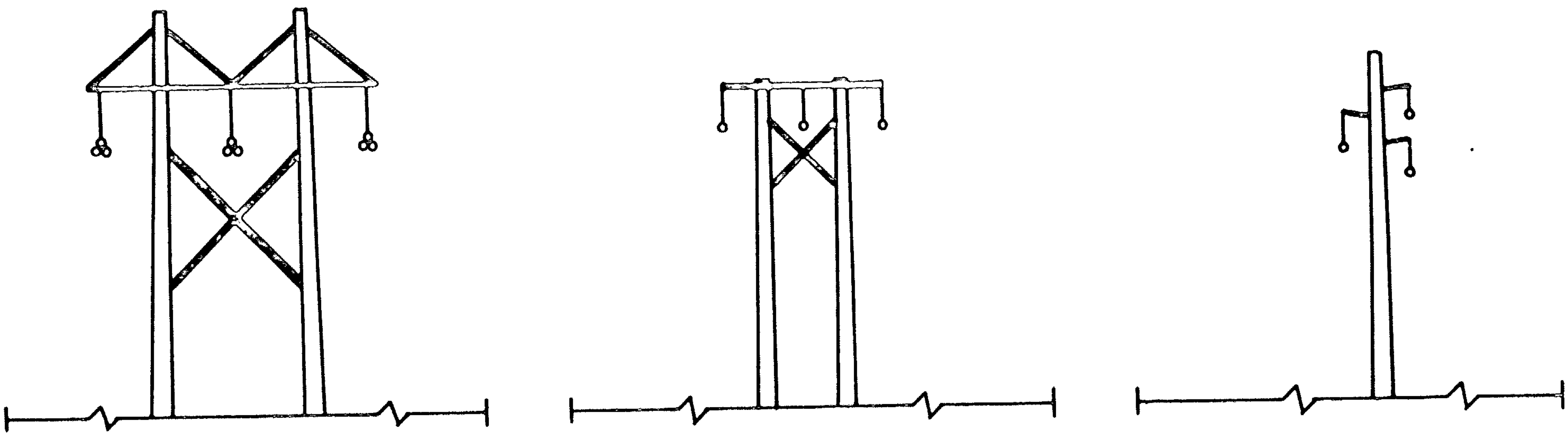
TYPICAL ENGINEERING CRITERIA FOR TRANSMISSION LINES

Voltage and Structure Type	Typical R-O-W Width	Design Ground Clearance	Average Structure Height	Average Span
34.5-kV Single Pole	0-50	26	30	300
69-kV Single Pole	0-50	26.5	50	350
115-kV Single Pole	0-70	26.5	65	350
115-kV H Frame	90	26.5	55	650
230-kV H Frame	100	29	65	700
345-kV H Frame	115	29	75	750

Note: All Figures in Feet

Table 2

CONFIGURATION OF TYPICAL TRANSMISSION STRUCTURES



WOOD POLE H-FRAME 345 KV

WOOD POLE H-FRAME 115 - 230 KV

SINGLE POLE WITH DAVIT ARM 34.5 - 69 KV

Figure 17

Dimensions are not given for these strutures because of the variability in heights.

Footings and Soil Stability - A very preliminary field reconnaissance and review of existing transmission construction indicates there should be relatively minor problems with structure footing conditions and soil stability. Drilling and blasting may be necessary in some areas of surface rock to set wood poles, however this would not be a major problem when anticipated and planned for at the construction planning phase. Geologic conditions will be a part of the environmental assessment on the project at a corridor level, however, and a consideration in the corridor selection process.

Utilization of Existing Rights-of-Way - The utilization of existing rights-of-way is a major consideration in any transmission line analysis. Under many conditions, it is highly desirable where possible to rebuild a line on an existing right-of-way to a higher capacity or parallel an existing line with a second right-of-way. This policy has been accepted by the public in that the existing access can be utilized for the new construction. It also requires less clearing than a new right-of-way under most conditions and is normally more acceptable from the standpoint of aesthetic and land use impacts.

ENVIRONMENTAL CONCERNS

The following discussion addresses major environmental concerns apparent at this early stage of the study. The degree, or severity, of impact in each category cannot be quantified at this time, hence, no attempt is made to do so. Still, these concerns do exist, and they are discussed in general, qualitative terms, based on the minimal information obtained by the study team to date.

Socioeconomic - This category generally includes changed land uses because of the right-of-way, construction impacts related to the introduction of workers and equipment into the area and surrounding communities during the construction period, and impacts related to operation and maintenance.

Land Use - The primary concern in this category appears to be loss of commercial forestland resulting from right-of-way clearing. This impact cannot be avoided, but can be reduced by locating the transmission lines away from the best commercial growing sites where possible. Constructing along already cleared land, such as parallel to an existing transmission line, railroad, or highway, reduces the amount of acreage taken out of production. Opportunities for this practice do exist within the study area, and will be explored.

Agricultural land is affected to a much lesser degree by a transmission right-of-way. Farming can take place within the right-of-way. However, the structures pose an inconvenience, and sometimes require altered cultivation patterns. The lower voltage lines (34.5-kV and 69-kV) pose a problem in aerial application of fertilizer or pesticides, but spray planes can normally fly under 115-kV and larger lines.

From a land use standpoint, a transmission line right-of-way appears compatible with commercial blueberry operations.

Compatibility between residential land use and a transmission line depends on the line voltage and design. No dwelling can be allowed to remain within the right-of-way. 34.5- and 69-kV lines can be located through residential communities, often following street curbs and back lot lines. This practice is generally precluded for larger lines by the greater clearances required. Because of the sparse population in the study area, it appears that few, if any, homes would require relocation.

Construction Impacts - During the construction period the people living along the route and in the surrounding communities are affected in varying degrees. Dust, smoke, and noise are present during clearing operations. Men, equipment, and materials, moving to and along the line cause increased traffic on highways and roads. With a transmission construction project in the vicinity, one can expect an increase in motel, restaurant, and bar trade. Temporary employment will be offered to some local workers. These and other construction-related concerns will be addressed in the study. At this early stage it is safe to predict, however, that these types of impacts, both positive and negative, will be slight and short-term, compared to those of the tidal power project itself. This is due to the relative small size of the construction project, its lineal nature, and the population distribution in the study area.

It should be noted, however that in the Eastport area, most socioeconomic impacts of transmission construction would be cumulative with those of the tidal power project, itself.

Operation and Maintenance Impacts - After construction, socioeconomic impacts to the area would be entirely different than those experienced when construction is underway. Maintenance activities typically consist of inspection patrols, equipment and road repairs, and selective vegetation removal - all performed infrequently. This work would employ very few people and would have little effect on the local economy or community services.

An energized transmission line may have the following electrical effects of concern:

Audible noise - a crackling sound heard near the conductor.
TV and radio interference - static or poor reception.
Electric field effects - induced currents and voltages to objects or organisms on the right-of-way.

At the voltage levels contemplated for this project, the above effects are not expected to pose any problems which cannot be prevented by proper design. However, the subject will be addressed in the study.

Natural Systems - The category, "Natural Systems" includes fish and wildlife resources, natural vegetation, hydrologic systems, and geotechnical concerns, such as soil erosion and sedimentation.

Wildlife - Recent studies in northern New England have indicated that a properly cleared and maintained transmission line right-of-way can actually enhance, rather than detract from the over-all value of wildlife habitat in the immediate area. Some species under certain conditions, however, can be adversely affected. Exactly what impacts would occur from this particular project cannot be determined until the transmission line corridors are identified and evaluated. Certainly deer wintering areas will be of concern, and must be identified during the course of the study, as well as waterfowl nesting areas or flyways and any suspected habitat for rare and endangered species. (Bald eagle nesting areas are an example.)

Aquatic Resources - The greatest potential for impact to fish populations could result from access road construction and right-of-way clearing in the vicinity of streams. Many streams in the study area support trout populations, and a few rivers are beginning to experience a return of atlantic salmon as a result of intensive management efforts. Stream bed disturbance and sedimentation in spawning areas are of primary concern. Clearing of vegetation along stream banks could increase water temperature, adversely affecting some cold water species. Indiscriminate use of herbicides could introduce harmful chemicals into water bodies. The above potential impacts can be nearly eliminated by proper line location, construction techniques, mitigation measures, and maintenance practices. They are recognized here as concerns to be addressed as the study proceeds - not because measurable impacts would necessarily occur.

Vegetation - Natural vegetation is altered within the transmission rights-of-way and eliminated at pole sites and access road surfaces. Modern clearing criteria call for selective right-of-way clearing, i.e., only trees which could interfere with the conductor are removed. Low growing trees and shrubs are retained. Road construction requires complete removal of all vegetation. These impacts are unavoidable.

Erosion and Water Quality - Removal of ground vegetation and disturbance of topsoil during construction accelerates erosion with the resulting siltation of natural drainage systems. Increased turbidity could occur in lakes, ponds, rivers, and streams in the vicinity of the rights-of-way. Roads and road construction activities can be a significant source of sediment. Poorly placed culverts can increase sediment loads, and fording of streams by heavy equipment will increase turbidity.

The potential for erosion and resulting impact on surface water systems will be an important factor in corridor selection and in determining transmission line routes within these corridors. Even more important is to minimize extensive erosion by insuring proper design and stringent specifications for construction and maintenance.

Cultural Resources - This category includes both the historic and prehistoric, or archeological resources of the area.

Historical Resources - The primary impact on historic sites would be visual, particularly if the transmission facilities interfere with the historical atmosphere of the site and the surrounding area. It is highly unlikely that the facilities would be located on or over part of a historic site.

The study area contains several known historic sites. The Maine State Historic Preservation Office will be consulted during the study regarding other sites not currently on the National Register of Historic Places, but which may have historical significance.

Archeological Resources - The primary importance of archeological sites lies in the knowledge that may be gained from a careful study of the structure of the site and the placement of the cultural and natural materials in the site. For the purpose of archeological studies it is important that the site be undisturbed until the studies are made. Disturbance of the site is irreversible and may seriously decrease its value for archeological study.

Because the locations of known archeologic sites are not generally made public, archeological authorities familiar with the area will be consulted to determine any possible conflicts with proposed transmission corridors. At a later date, if the project is approved for construction and an actual centerline developed, an intensive archeological survey at each structure site and along each planned access road will be conducted to identify previously unknown sites.

Visual - Every overhead transmission line involves a certain degree of visual impact. In recent years a great deal of attention has been given to visual concerns, in both location and design of transmission facilities. Consequently, guidelines and criteria addressing this issue have been established by many government agencies and utilities. Even so, visual impacts cannot be eliminated - only modified.

Aesthetics - The study area is characterized by a divergent landscape; scenic coastland, large forested areas, blueberry fields, many lakes, ponds, rivers and streams, and an area of low but fairly steep mountains. The landscape scenic quality, and the impact of transmission facilities on aesthetics will be addressed in the vis ıal studies for this project.

Residential - Residential areas are of special concern, and there are two schools of thought on this subject. Some feel that transmission lines are fairly compatible with populated areas because of the presence of many other manmade structures and facilities, as opposed to a location through areas relatively undisturbed by man. The other line of reasoning is that no one should be subjected to a constant view of a transmission line, and that they should be kept out of sight of permanent residences. Recognizing both viewpoints, the study team will examine each individual situation where rural residences or communities are involved. Some transmission corridors will probably pass through or near populated areas. However, in these cases, prominent views of transmission structures from dwellings will be avoided wherever possible in final centerline location. Much can also be done in the way of screening by terrain or natural vegetation.

Transportation Systems - Views of the transmission right-of-way and structures from roads and highways are important visual concerns, a fact particularly true in this study area because of the scenic beauty of the landscape. A number of highways would be crossed by the lines on some of the alternative plans. Special consideration will be given to these crossings to minimize prominent views of structures or right-of-way clearing by the traveling public. Techniques to minimize these impacts include: crossing on a highway curve, crossing at a highway cut section, terrain and vegetative screening of structures, and angles in the line to eliminate long views of the cleared right-of-way. Corridors will be located to take advantage of the opportunity for these mitigation techniques, however, some visual impact to transportation systems will occur.

Recreation - Because of the scenic character of this portion of Maine, and its recreational resources, some alternative transmission corridors will undoubtedly pass near or through existing and potential recreation areas. Visually, transmission systems can dominate views and affect the scenic values of the area when these obvious, manmade features intrude in a natural setting. This contrast can detract from an individual's recreational experience based on the enjoyment of natural aesthetic features.

Picnic areas, campgrounds, parks, wildlife refuges, hiking trails, canoe and fishing streams, lakes, ponds, and scenic highways and roads can all be found in the study area, and could all be adversely impacted to some degree by a view of the transmission lines.

A possible benefit would be the potential for development of snowmobile trails along the rights-of-way where individual landowners do not object.